

Code No: R09220103

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

B.Tech II Year II Semester Examinations, May-2013

Hydraulics and Hydraulic Machinery

(Civil Engineering)

Time: 3 hours

Max. Marks: 75

Answer any five questions  
All questions carry equal marks

- 1.a) Distinguish clearly between the following for a open channel flow:  
i) Gradually varied flow and rapidly varied flow  
ii) Hydraulic gradient line and total energy line  
iii) Subcritical flow and super critical flow.
- b) A trapezoidal canal of most efficient section with side slopes of 1:1 is required to carry  $14 \text{ m}^3/\text{sec}$  with a bottom slope of 1 in 1000. The value of Chezy's  $C = 45$ . Find the bottom width and depth of the channel. If the value of  $C$  can be increased to 70 by lining the canal, what may be the percentage increase in discharge? [6+9]
- 2.a) Derive the expression for depth after jump  $d_2$ :

$$d_2 = \frac{d_1}{2} \left[ \sqrt{1 + 8Fr_1^2} - 1 \right]$$

- Where  $d_1$  is the depth before jump and  $Fr_1$  is the Froude's number before jump.
- b) Find the length of the Back-Water curve caused by an afflux of 1.5m in a rectangular channel of width 50m and depth 2m. Take slope of the bed as 1 in 2000 and Manning's  $N$  as 0.03. [7+8]

- 3.a) What do you understand by  $\pi$ -terms? What are their characteristics? How are they useful in dimensional analysis? Explain.
- b) A model of a weir is constructed with a vertical scale of 1:16. If the discharges of the model and prototype are  $1.5 \text{ lit/sec}$  and  $38.4 \text{ m}^3/\text{sec}$  respectively, find the horizontal scale of the model. [7+8]

- 4.a) When the jet strikes a fixed plate at an inclination of  $\theta$ , the discharge  $Q$  gets divided into two portions  $Q_1$  and  $Q_2$ . Derive the expressions to find the values of  $Q_1$  and  $Q_2$ .

- b) A jet of water 100mm diameter impinges with a velocity of 25m/sec on a plate moving with a velocity of 10m/sec in the direction of the jet. Find the force exerted by the jet. If the plate is now replaced with a series of vanes moving with the same velocity as that of the plate, find the force exerted by the jet on the vanes. [6+9]

- 5.a) Draw a neat sketch of a Francis turbine showing the different components and explain its working.

- b) A Pelton wheel is required to work under a head of 39.6m and to develop 101.4 hp at 250 rpm. Assuming an efficiency of 80% and a  $C_v$  of 0.98, find the jet diameter, diameter of the bucket circle, the size of the buckets and the number of buckets required. Take the speed ratio as 0.45. [8+8]

6.a) How a specific speed differs from a unit speed in a turbine? Explain.

b) It is proposed to develop 100,000 BHP (75,000 kW) by a number of hydraulic turbines. Each of the turbines runs at 166.7rpm, when working under a head of 30m. Find the number of turbines to be employed if the specific speed of each turbine is 335.

[6+9]

7.a) Explain the different losses occurring during the operation of a centrifugal pump in the following cases:

- i) between shaft and impeller
- ii) between impeller and casing exit, and
- iii) between casing exit and delivering pipe exit.

b) A centrifugal pump running at 1400 rpm at a manometric efficiency of 85% carries 180 lit/sec of water as discharge. The outlet vane angle of the impeller  $\phi$  is  $45^\circ$  and the velocity of flow at the outlet is 3.0 m/sec. If the pump works against a total head of 20m, determine the diameter of the impeller and its width at the outlet.

[9+6]

8.a) Explain the following terms:

- i) Demand factor
- ii) Diversity factor
- iii) Load factor.

b) The average annual yield of a river at a dam site is 6000 hectare-meters. A dam is to be built to provide an average net head of 30m on the turbines. Find the potential water power available from this hydel scheme. If the overall efficiency of turbine is 90% and the overall efficiency of generator is 96%, find the electrical energy in KWH available from this scheme.

[6+9]



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